Wireless Telecommunications Facilities Policy

A Technology Vision
for 2020
and Beyond

DRAFT

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ROANOKE

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Introduction:

The purpose of this document is to provide applicants, service providers, property owners, and all City residents clear guidance on the policies of the City of Roanoke regarding Wireless Telecommunications Facilities (WTF) on public and private land. The policies established, and the standards and approaches recommended, by this document should be used by wireless telecommunications service providers and tower development entities as a guide when selecting WTF sites and designs within the City. In addition, the City of Roanoke should use these policies as a guide in the review and evaluation of any requests for Wireless Telecommunications Facilities, including the amendment of development regulations within the City's Zoning Ordinance. Such standards and regulations should create a uniform approach toward analyzing and processing Wireless Telecommunications Facilities siting requests from a land use perspective.

History of Wireless Planning in the City of Roanoke:

In the 1980s, the first generation of cell phones was launched. These were large, bulky phones on an analog system with the limited ability of making and receiving phone calls. This was followed in the 1990s by second and third generation phones. Devices continued to shrink in size while expanding capabilities including texting, internet access, and Global Positioning System (GPS) navigation on a digital network. The 1990s is really when cell phones became mainstream and providers began rapidly expanding their network infrastructure. Collocations were unheard of, with each carrier erecting their own towers and antennas.

Many localities nationwide began regulating these facilities and in many cases prohibited them all together. In response, because of Federal Licensure for the frequencies managed by the Federal Communications Commission (FCC) as a "Federal Undertaking", Section 704 of the Telecommunications Act of 1996 (47 USC_332) was adopted which preserved local zoning authority but imposed four limitations for local government.

1. Shall not "unreasonably discriminate" among providers of functionally equivalent services and shall not prohibit or have the effect of prohibiting service.
2. Must act on a request within "reasonable period of time". This was further defined in 2009 by the "shot clock" ruling which requires localities to act upon a wireless application within 90 days for collocations and 150 days for new towers.
3. Decision to deny must be "in writing" and supported by "substantial evidence".
4. All sites must conform to all published Federal Code and Practices concerning radio frequency (RF) emissions.

After the *1996 Telecommunications Act*, the City of Roanoke began actively planning for Wireless Telecommunications Facilities. In 1997, City Council adopted a policy for communications towers sited on City-owned land. The adoption of *Vision 2001-2020, the City's Comprehensive Plan* in August 2001 further established general policies on wireless telecommunications facilities.

- 3.4 Infrastructure: Transportation, Technology, Utilities
  - IN P6. Technology environment and infrastructure. Roanoke will create an environment for electronic government and technology businesses through planning, development of favorable policies, and incentives for technology infrastructure. Roanoke will facilitate development of the capacity and coverage of fiber-optic, cable, and wireless communication networks. The visual impact of telecommunication facilities will be minimized by co-location and placement of towers in strategic locations.

- 3.2 Environmental, Cultural, and Historic Resources
  - EC A11. Adopt zoning regulations that address communication towers to minimize their visual impact.

In 2004, the City adopted the *Wireless Telecommunications Facilities Policy* regarding the visibility and visual impact of wireless infrastructure across the entire City. This was followed by the inclusion of wireless facilities in the text of the newly adopted Zoning Ordinance in 2005. Since that time, this policy and the zoning regulations have remained the same while the wireless industry has seen dramatic change in terms of consumer demand, available technology, and federal regulation.

Demand on Wireless Providers:

Consumers are increasingly relying upon cell phones, smart phones, and the wide range of wireless devices available instead of landline phones and wireline internet connections. Dependable access without signal loss is viewed by many as essential to their daily lives. The increasing number of wireless users, wireless devices, and data traffic, including the continued evolution of broadband networks deployed by "Generations" or "G" such as (1G/analog, 2G/cell phone, 3G/smart phone, 4G/universal personal communicator device, and soon 5G), will mean more wireless telecommunications facilities will be required to build enough capacity to meet demands.

National studies by industry leaders and nonpartisan fact tanks alike have consistently backed these claims with real numbers. A local on-line survey with 125 respondents conducted by the Department of Planning, Building, and Development from March 9, 2015 to April 20, 2015 yielded similar results. Most respondents reported that they saw their wireless device(s) as a necessity (81%); used phone and/or data service several times a day (86%); and had cancelled their land line phone (60%); but rated their quality of coverage at their residence as average (41%) or poor (20%).

The demand is here, the service is not, and providers will respond. The ever increasing number of wireless users coupled with the launch of new generations in wireless technology has had and will have a significant impact on demand. Wireless providers must consider both coverage (geographical area) and capacity (number of users) to deliver the services expected by their customers which will result in expanded infrastructure.

Available and Emerging Technology:

A. Near Term ------2016 - 2020

Successful wireless service requires the principle of what is known as "Up-link and Down-link". Simply put, the wireless device must be able to "Receive" the transmission from the WTF and then be able to "Transmit" back to the WTF to complete the channel linkage. This will be the challenge in the "wireless world" because of the location of the telecommunications device (Smart Phone, Tablet, Device/Cell phone, etc.) in relationship to the WTF.

Wireless service requires both coverage of particular areas and channel capacity within those areas to be fully functional. The technology surrounding wireless infrastructure is continually evolving to meet the demands of consumers. As radio coverage evolves in strategic deployment of antenna placement and channel creation, new technologies have been developed to meet growing demand such as DAS (Distributed Antenna Systems) and other small/micro cell systems that seen as viable alternatives to address both coverage and capacity within systems.

Cell Hierarchy for Wireless Telecommunications Facilities

The basic principle in the deployment of wireless technology for current 4G and future technology innovations is the wireless telecommunications facility. Towers, rooftops, water tanks, tall signs and any elevated structures can accommodate antennas and equipment. This is why the reference to wireless telecommunications facilities or "WTF" encompasses several basic components. They are:

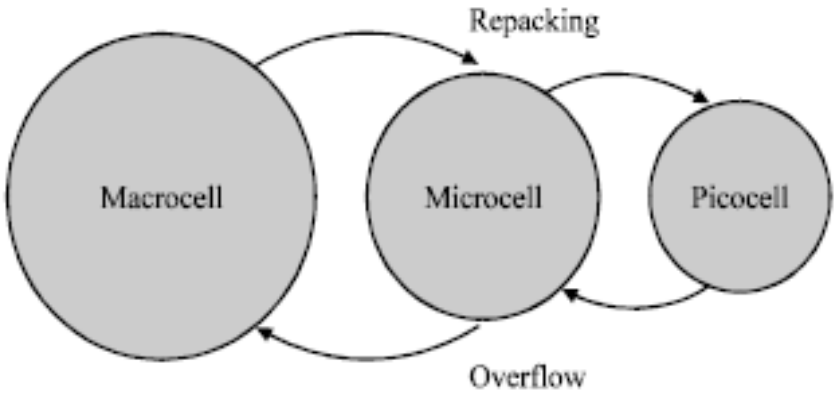
1. Antennas
2. Cable
3. Base Equipment cabinets/shelter
4. Power source
5. Backhaul capability
6. Mounting devices
7. Structure to mount to: tower, water tank, street lamp post, roof tops, commercial signage, etc.

Think of “Cell Sites” in three classifications from a height and equipment perspective

They are:

1. Macrocell…….. 150’ to 199’ AGL with a 9 to 16 antenna panel array.
2. Microcell…… 100’ to 150’ AGL with a 6 to 9 antenna panel array.
3. Picocell…….. 40’ to 99’ AGL with a 1to 3 antenna panel array.

The networks of today and the future will include all 3 types of “Cell Sites”.

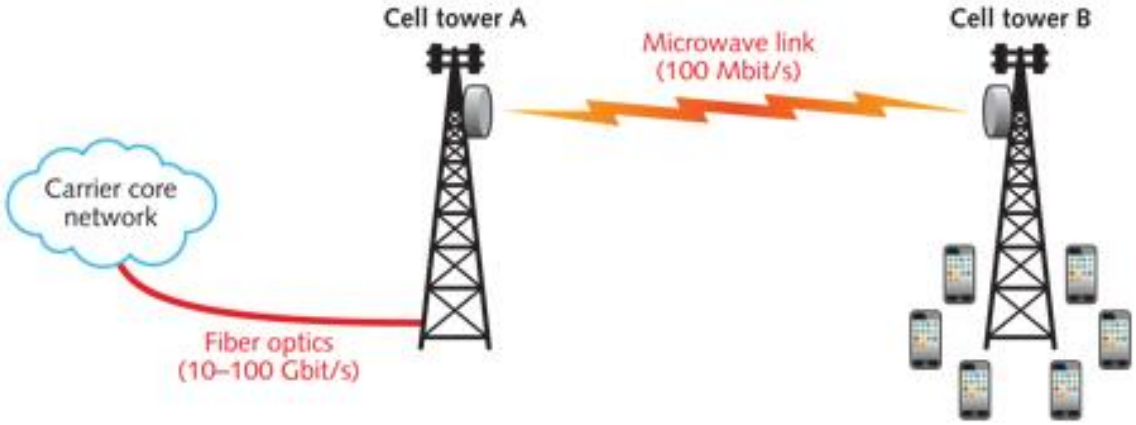


Macrocell Systems

Macrocell (or Full Site) systems enable service providers to deliver voice, text, and broadband communications through high powered radiofrequency (RF) signals to large geographic areas. These systems are typically characterized by multiple provider antennas affixed to tall, freestanding towers (on platforms for each service provider known as “slots”), the top of tall buildings, or water tanks.

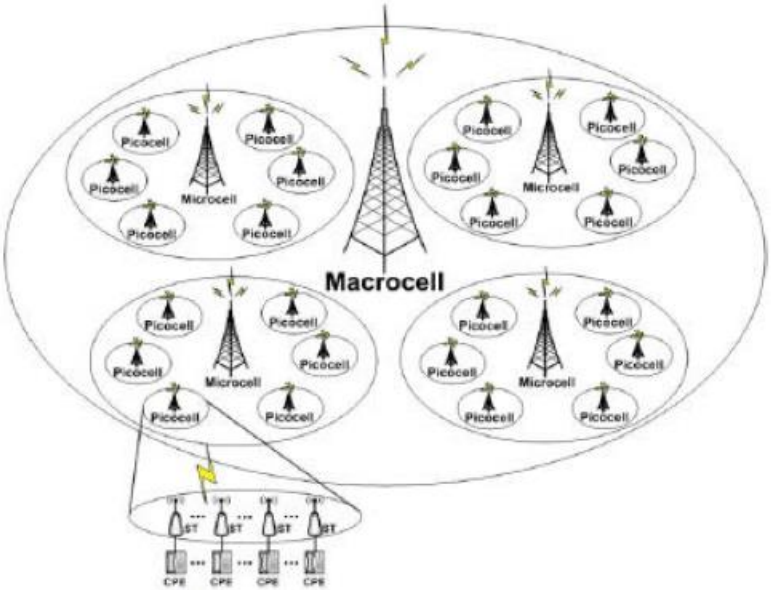
Macrocells have the highest coverage and capacity capabilities of all system types; however, increasing demand for wireless technology is quickly exceeding the network capacity of these sites. In other words, regardless of how far a wireless signal is able to penetrate a defined geographic area, each facility can still only accommodate a certain number of consumers/subscribers at a time. More demand and fewer channels to accommodate this demand are known as “Channel Congestion”. Therefore, more facilities at lower heights or the deployment of supplemental systems are most effective in high density areas.

Typical Macrocell



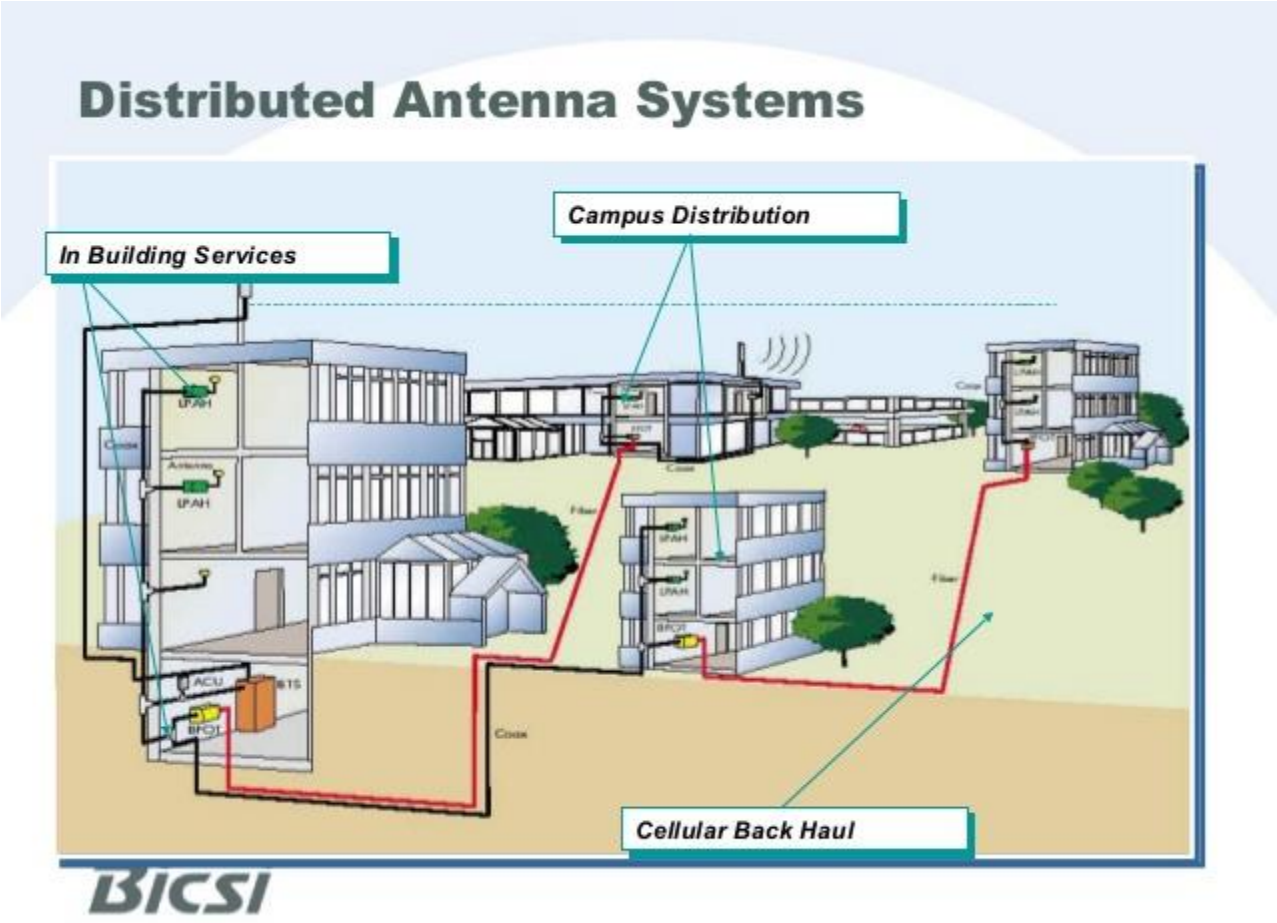
Small Cell Systems

Small cell system is an umbrella term for **Microcell and Picocell systems**. These systems provide small footprint coverage to high traffic areas in need of supplemental capacity to support existing macrocell coverage much like Distributive Antenna Systems or "DAS". The advantages of a Small Cell System are the ability to deploy individually to support a larger network and that the costs are less than that of DAS technology. However, while small cell systems are cheaper to install than DAS, they are typically installed piecemeal in isolated areas rather than as part of a larger system and are limited to one carrier per unit (accommodating as few as 80 users). The disadvantages for Small Cell Systems are that they have limited band width and can only deliver a single wireless communication technology. They are typically placed at low elevations on buildings or poles in the public right of ways.



Distributed Antenna Systems (DAS)

Distributed Antenna Systems (DAS) increase capacity of existing macrocell systems by distributing radiofrequency signals in a small defined geographic area from, and aggregate return signals to, a central hub. They typically cover targeted areas both indoors and outdoors with medium to high capacity requirements. One DAS unit transceiver can support one carrier. Multiple carriers use DAS to support their individual networks. The design capacity for DAS (each accommodating up to 200 simultaneous users subscribers) support Wi-Fi which can be used to off-load data traffic from capacity constrained macrocell systems, and can be deployed individually covering a few blocks or as part of a larger system serving an entire city.

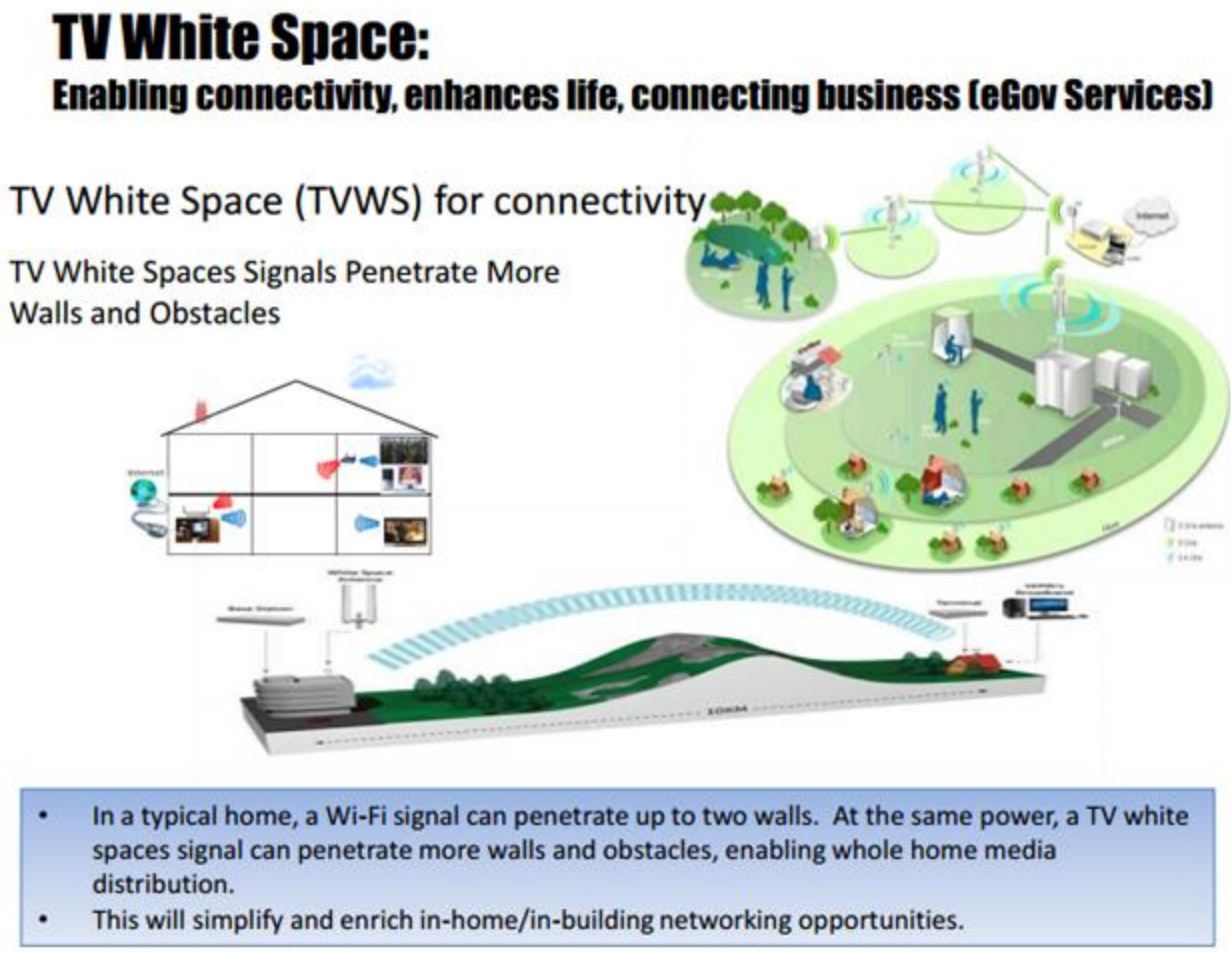


DAS systems are typically placed on buildings or existing poles in the public right-of-way such as utility, street lights, traffic signals, and so forth at relatively low and uniform heights and then hardwired back to a central hub. The systems are very scalable and efficient, but have high initial costs due to design and the construction complexity of the network.

B. Far Term-----2020 and Beyond

WhiteFi

On the horizon is the use of television surplus analog frequency known as "White Space" or "WhiteFi" which allows longer transmissions and more penetration into buildings and urban canyons. This would make the deployment of higher speed services like 4G LTE more cost effective. The Federal Communications Commission (FCC) planned to auction off parts of the TV spectrum, voluntarily provided by broadcasters for compensation, in mid-2015 to wireless carriers. The National Association of Broadcasters challenged the auction through a lawsuit filed in November 2014 citing potential loss of viewership effectively stalling the auction until a final ruling.



WiMAX

Worldwide Interoperability for Microwave Access:

Wi-Max is like Wi-Fi but it has higher data rate speed over greater distances and can retain more users. Its main purpose is Internet Everywhere. WiMAX will take desktop computing and change it smoothly into the mobile laptop. It can enable you to take your laptop mobile anywhere you want with internet connectivity; the same way you are carrying your mobile phone with you.

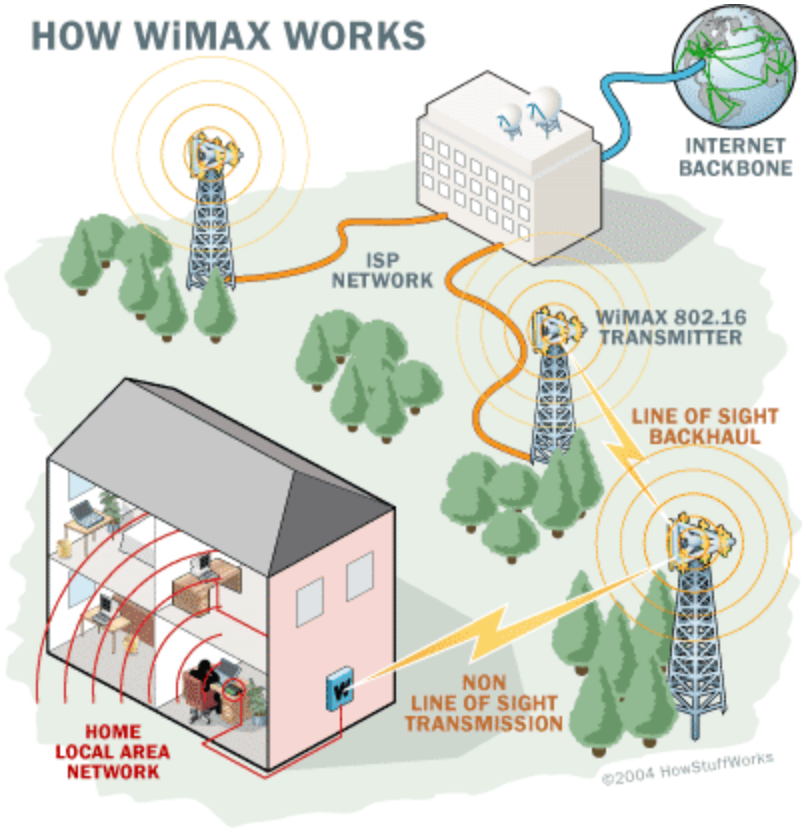
WiMAX is designed to deliver broadband multimedia data ubiquitously over wireless links. It mainly consists of two things. A tower and receiver.

> **A WiMAX tower:** Similar in concept to a cell-phone tower - A single WiMAX tower can provide coverage to a very large area -- as big as 3,000 square miles (~8,000 square km).
> **A WiMAX receiver:** The receiver and antenna could be a small box or they could be built into a laptop the way WiFi access is today.

Benefits:

WiFi provides high bandwith but not distance; current cellular systems provide distance but not high bandwith where Wi-Max provides both.

Wi-Max will give a rich variety of uninterrupted high-bandwidth services to users in offices, homes, coffee shops, airports, and hotels, urban and sub-urban areas.



5G -2020 & Beyond *(Source Wikipedia)*

5G (5th generation mobile networks or 5th generation wireless systems) denotes the next major phase of mobile telecommunications standards beyond the current 4G/IMT-Advanced standards. 5G has speeds beyond what the current 4G can offer. The Next Generation Mobile Networks Alliance defines the following requirements for 5G networks:

a. Data rates of tens of megabits per second should be supported for tens of thousands of users;

b. 1 gigabit per second to be offered simultaneously to many workers on the same office floor;

c. Several hundreds of thousands of simultaneous connections to be supported for massive sensor deployments;

d. Radio spectrum efficiency should be significantly enhanced compared to 4G;

e. Coverage should be improved;

f. Coverage efficiency should be enhanced; and

g. Frequency interference should be reduced significantly compared to LTE.

The Next Generation Mobile Networks Alliance feels that 5G should be rolled out by 2020 to meet business and consumer demands. In addition to providing simply faster speeds, they predict that 5G networks also will need to meet the needs of new use cases, such as the Internet of Things (network equipment in buildings or vehicles for web access) as well as broadcast-like services and lifeline communication in times of natural disaster.

Although updated standards that define capabilities beyond those defined in the current 4G standards are under consideration, those new capabilities have been grouped under the current ITU-T 4G standards.

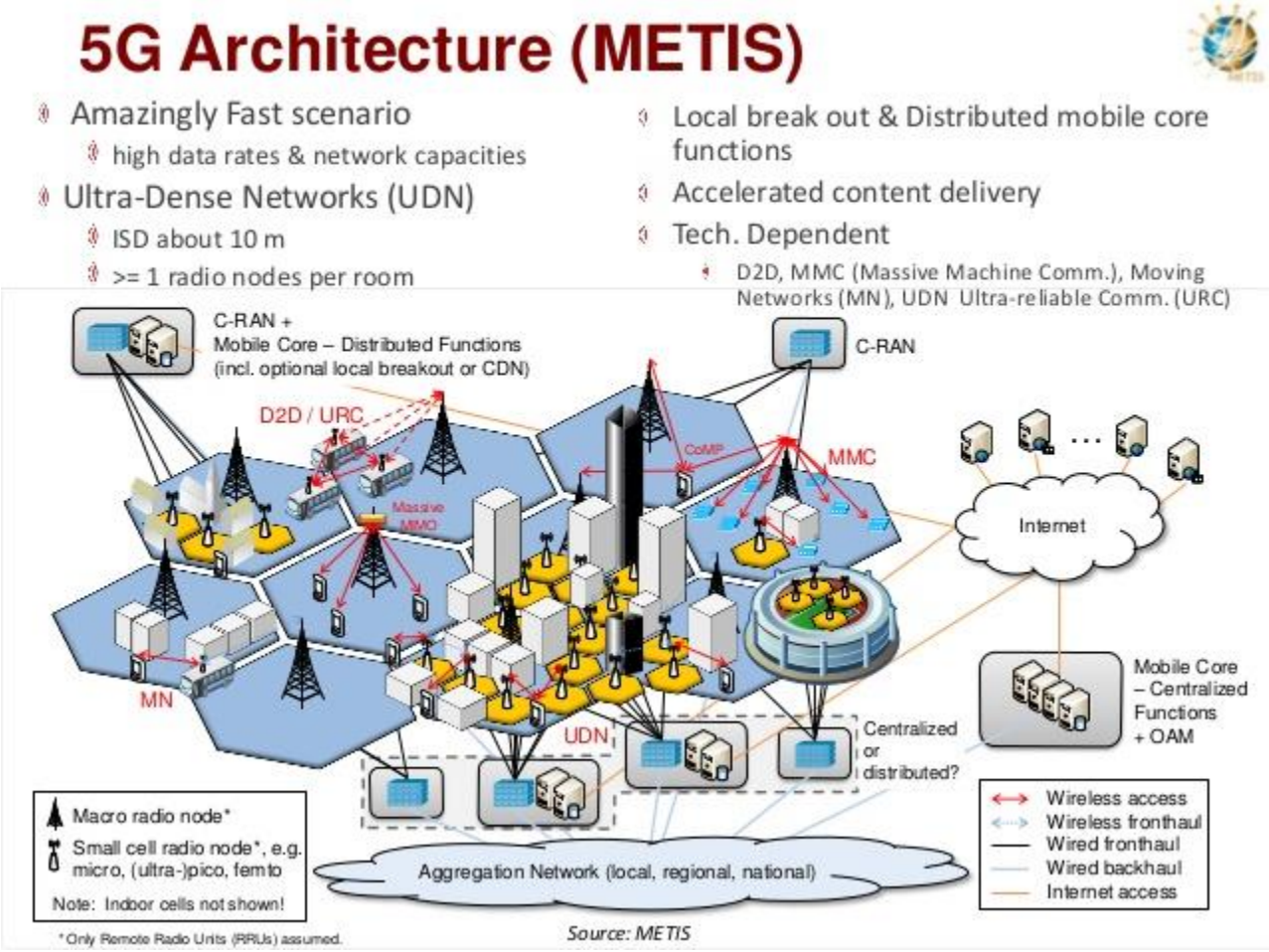
In July 2015, the European 5G research project **Flex5Gware** was launched. The objective of Flex5Gware is to deliver highly reconfigurable hardware (HW) platforms together with HW-agnostic software (SW) platforms targeting both network elements and devices and taking into account increased capacity, reduced energy footprint, as well as scalability and modularity, to enable a smooth transition from 4G mobile wireless systems to 5G. This will ensure that 5G HW/SW platforms can meet the requirements imposed by the anticipated exponential growth in mobile data traffic (1000 fold increase) together with the large diversity of applications (from low bit-rate/power for M2M to interactive and high resolution applications). On January 29, 2016, Google revealed that they are developing a 5G network called **Sky Bender**. They planned to distribute this connection through sun-powered drones.

METIS

"***M**obile and wireless communications **E**nablers for **T**wenty-twenty (2020) **I**nformation **S**ociety.*"

METIS is co-funded by the European Commission as an Integrated Project under the Seventh Framework Programmed for research and development (FP7). The project will provide an important platform for a European-led early global consensus on fundamental questions connected to the development of the future mobile and wireless communications system, and pave the way for future standardization.

The project objective is to lay the foundation for a future mobile and wireless communications system for 2020 and beyond. METIS is a consortium of 29 partners coordinated by Ericsson. Approximately 80 persons will be dedicated full time to METIS during its 30-month duration. The strong consortium includes manufacturers, network telecommunications operators, academic institutions, automotive industry and a research center.



Summary of the Technology future

As the next generation of wireless technology is either being deployed or is still under research and development, the certainty is that the trend to wireless and the versatility of personal devices and the consumer demand will continue to increase. As 5-G or 5th Generation, WhiteFi, WiMAX, and other untold emerging technologies are deployed, there will be several issues that local governments must address and contend with. A few of the concerns of local government include wireless telecommunications facilities (tower and ground equipment), adherence with building codes, and compliance with all applicable Federal and State guidelines and regulations including historic and preservation concerns.

With the advent of new technologies, there will be a "hybridization" of various parts of the systems being "outsourced" or "partnered" with other and even competing service providers. Because all service providers will require a "pathway" to the world-wide-web and cloud data storage, it will become vital that most existing and future service providers accomplish this by the cross networking of "backhaul" transport technologies. With this being said, the current Applicant is the "Last Mile" provider, but in the future, the Applicants may be the Backhaul or provisioning service provider. This will be a change from the current Application process.

Understanding the technology and future requirements will assist in the future deployment as The City of Roanoke seeks to serve its citizens and their demand for wireless services.

Federal Regulation:

Since the 1996 Telecommunications Act, (CFR Title 47 Parts 0-199) Congress and the Federal Communications Commission (FCC) have sought to further expedite the deployment of wireless telecommunications facilities. Most recently, Section 6409 of the Middle Class Tax Relief and Job Creation Act of 2012 (47 USC_1455) directed the FCC to remove obstacles to the modification process of wireless facilities. This Section requires a State or local government to not deny, and approve any eligible request for a modification that does not substantially change the physical dimensions of the tower or base station that were legally established. Eligible modifications to a tower or base station include the collocation of new transmission equipment, removal of transmission equipment, or the replacement of transmission equipment. This ruling does not relieve the FCC from the requirements of the National Historic Preservation Act or the National Environmental Policy Act of 1969.

The FCC further clarified the parameters of a substantial change. It is defined as:

The addition of an antenna

(1) On a tower that would increase the height by more than 10% or 20 vertical feet,

(2) That required installation of more than standard number of equipment cabinets (over 4) or more than 1 new equipment shelter,

(3) That would increase girth (width) of the tower by more than 20 feet;

(4) Would involve excavation around the tower site beyond the existing boundaries of the property associated with the facility.

(5) A substantial change would also include defeating the concealment elements of a stealth wireless facility.

In accordance with the FCC Report and Order, this ruling went into effect April 9, 2015.

Policy Development:

Since the last policy was drafted in 2004, significant changes have occurred in the wireless industry as evident by the introduction to this document. In order to address the changes in consumer demand, available technology, and federal regulation, the City of Roanoke began a process to update this policy by enlisting assistance from the Roanoke Valley-Alleghany Regional Commission (RVARC), a consultant specialized in wireless telecommunications facilities, and input from residents and stakeholders

Prepared by the staff of Roanoke Valley-Alleghany Regional Commission and dated November 24, 2014, the *City of Roanoke Wireless Telecommunications Facilities Policy and Regulations Background Information and General Recommendations* directed the City to explore: expanded collocation options and administrative review of noninvasive facilities; clear policies that are applied equitably; and community engagement and professional assistance from outside consultants.

The City further sought assistance from citizens via survey and public input meetings, while contracting with a consultant specializing in wireless telecommunications facilities. The input received through this process was invaluable and all comments were carefully considered when drafting the policies and actions found in this document. Below are short synopsizes of input received through the survey and public input meetings. Complete survey results may be found in Appendix B of this document.

1. A survey of conducted between March 9, 2015 and April 20, 2015 with 152 respondents revealed that more, smaller wireless facilities were preferred over fewer, taller facilities with stealth facilities and wooden masts extending 10 feet over the tree line the most popular options. Respondents also responded well to DAS facilities especially within the public right-of-way and asked that towers be removed if they became obsolete. Preferred locations that took into consideration factors above and beyond land use to include topography, neighborhood preservation, and available technology noting that most lower economic neighborhoods were adjacent to industrial zoning and would be disproportionately affected.

2. An initial public input meeting was held on Tuesday, April 14, 2015 in the Auditorium of the Main Library. The meeting was publicized twice through MyRoanoke, email blasts from Neighborhood Services, social media, and a WSLS10 interview which aired several times. In total, six persons attended representing members of the wireless industry,

government, and the community. Most comments centered on the visual impacts and viability of available and emerging technology, crafting predictable regulations, and realities faced by the wireless industry.

3. Two public meetings were held on April 7th, 2016 at the Municipal Building with a Noon session and an evening session that followed. The meetings were publicized through MyRoanoke, email blasts from Neighborhood Services, social media, and several media interviews. In total, eight individuals attended representing members of the wireless industry, government, and the community. The input stressed a focus on stealth facilities and the use of an outside consultant to help review proposals for wireless facilities.

Policies and Actions:

The purpose of the policy update is to (1) ensure the City's policy is in compliance with federal and state regulations (2) address advances in technology (3) minimize the visual impact of facilities, and (4) promote comprehensive wireless coverage and capacity in the City of Roanoke. This policy and subsequent Ordinance amendments must also be proactively monitored and updated to ensure timely response to new technology and changes in regulation.

As a result of the input received throughout the policy development process, the following Policies and Actions have been developed to accommodate and work toward the delivery of wireless service while maintaining the beauty and splendor of the City.

1. Regularly amend Zoning Ordinance to keep up with changing technology and regulations.
    a) Seek updates on a five (5) year cycle.
    b) Regulations should protect the character, scale, viability, and quality of life of the City's neighborhoods and commercial districts.
    c) Regulations should provide for the reasonable removal of discontinued wireless telecommunications towers and related facilities.
    d) Expand the types of Wireless Telecommunication Facilities covered and permitted by the Zoning Ordinance.
    e) By-right Administrative review and approval for wireless facilities deemed unobtrusive and that meet all design, planning and Land Use requirements.
    f) Seek a regional approach to the deployment of Wireless Telecommunications Facilities; therefore, such guidelines should be consistent with those of surrounding jurisdictions.

2. Establish Technical Review Standards
    a) Institute a process and fee for utilizing a Third Party Consultant to assist the City in evaluating each Application for the possible alternatives and potential impacts of a Special Exception or Rezoning request for a Wireless Telecommunications Facility.

i. 3rd party review fees shall be agreed upon by the City and Reviewing party on an Annual Basis.
ii. Fees shall be commensurate with efforts required to review to include public hearings, site visits and technical analysis with report.
iii. The Fee will be a flat fee that the Applicant will be made aware of and agree to prior to submission of the Application.

b) Provide a Technical Review based on acceptable industry deployment standards, City Planning and Zoning Requirements, Federal and State Requirements within a timely schedule and approval process for applicants.
   i. Ensure terminology is well defined to assist in accurate communication.
   ii. Ensure easy navigation of the supplemental regulations by dividing into easily identified sections dependent on type.
   iii. Provide applicants a comprehensive list of submittal requirements that are tailored to each facility type.
   iv. Ensure that the type of facility necessitates the submittal requirements and are not overly burdensome while still allowing the City to thoroughly review the facility for compliance with standards.

c) Technical Standards Information- The following is a list of information that may be required for each WTF Application:
   i. Documentation of the type of service, Licensed or Un-licensed frequencies and the area needs for proposed location;
   ii. Existing structures and collocation sites considered and rejected by the provider and the reasons why;
   iii. Photo simulations and balloon tests to illustrate visibility of the proposed facility;
   iv. Scaled plans depicting location of facility on the site, including setback dimensions performed by a Registered Professional Engineer in the Commonwealth of Virginia (COVA);
   v. Design and photos of the specific type of support structure;
   vi. Design and location of all associated equipment, structures, cabinet, shelters, or buildings;
   vii. Design, type, location, height, and configuration of all potential future antennas;
   viii. Landscaping, screening, and security fencing plans;
   ix. Proposed support structure's design and its capability to support other providers;
   x. Certification of the structural integrity of the support structure as affected by the attachment or location of proposed Wireless Telecommunications Facilities; and
   xi. Justification of the requested height and location.
   xii. Within flight path of Roanoke Airport or hospital transport.
   xiii. Documentation of FAA exemption. If <35 feet Above Ground Level (AGL) does not require FAA or hospital helicopter verification in Airport Navigation Overlay District (AN). TOWAIR.

xiv. Historical Review Section 106 with Commonwealth of Virginia (COVA) State Historic Preservation Officer (SHPO) comments.
xv. NEPA Analysis with comments from COVA Department of conservation and Recreation (DCR).
xvi. Radio Frequency Justification Statement from Applicant with Network Narrative, Radio Propagation models and immediate network.
xvii. RF Certification for Non-Ionizing Energy Report (NIER).

3. Approval Process and Regulations for WTFs should consider
    a) The Approval Process for WTFs should be set to incentivize service providers to install preferred facility types as outlined in Appendix: C.
    b) When appropriate, such facilities should be approved administratively.
    c) Stealth Technology should be encouraged and should not require a Public Hearing if the Staff and consultant believe that this deployment will not be counterproductive to the community.
    d) Facilities where a site specific assessment is necessary should be approved by Special Exception.
    e) Facilities should be reviewed by the Third Party Consultant as to technology and deployment.

4. Ensure placement of WTF within the City is based upon comprehensive coverage and capacity needs.
    a) It is the applicant's burden to substantiate that the requested location is necessary for service coverage and that the proposed facility is the least intrusive means to close a significant gap in service. Documentation must be provided.
    b) Consideration of any request for a new Wireless Telecommunications Facility within the City should also be reviewed for its potential effects on surrounding jurisdictions for coverage.

5. Seek collocation on existing structures as a first choice as opposed to building a new structure.
    a) Facilities with minimal visibility or collocating without exceeding previous approved heights should be handled administratively with subsequent approval if standards are met.
    b) The Roanoke Valley Broadband Authority has developed a web site with the compilation of data of fiber optic cable, Wireless Telecommunications Facilities, Water tanks etc. This site may assist with the collocation of facilities and can be found at: http://highspeedroanoke.net/
    c) All new facilities should be designed to accommodate additional collocation opportunities.
    d) Collocations which result in adverse visual impact, such as vertical collocations that increase the height of a structure or the size or projection of antenna arrays from the support structure should be discouraged.

6. Stealth Technology Goals for new WTFs
    a) The use of stealth wireless facilities (camouflage, disguise, concealment) is strongly encouraged.
        i. Allow for flexibility in the type of antenna used on a host structure to ensure that the antenna does not dominate the structure and does not exceed the height allowed by the zoning district.
        ii. Disguised stealth facilities should be of an appropriate design and scale to the surrounding environment.
        iii. Whenever necessary, the engagement of an Architect or specialist in Stealth technology should be used to offer the proper size and scale and visual effects.
    b) Require design features that make wireless infrastructure as visually unobtrusive as possible. Use natural existing land or city scape to blend WTF into the immediate area.
    c) Seek stealth technology for WTFs that will adhere to established standards that may be approved administratively.

7. Placement of Antennas on Host Support Structure Goals
    a) The placement, construction, or modification of Wireless Telecommunications Facilities on existing host structures such as buildings and utility infrastructure reduce the need to erect freestanding towers and are strongly encouraged.
    b) Roof-mounted facilities are acceptable but should be of a scale and color that are in keeping with the roof.
        i. It is preferable that roof-mounted facilities be flush-mounted on the parapet or a penthouse rather than projecting upwardly.
        ii. If roof mounted, they should be screened like other rooftop mechanical equipment.
        iii. Panel antennas should be located so that they do not peak above the roofline and should be positioned below the parapet.
    c) Antennas on utility poles should be mounted close to, or flush-mounted against the pole. If located on top of the pole, overhang should be limited.
    d) Encourage placement on existing host structures within the public right-of-way.

8. WTFs in Public Rights of Way
    a) Pico Cell systems can be located within the right-of-way and easements with coordination and permission from the Transportation Division of the City of Roanoke and any other lawful coordinating organization.
    b) Franchise Agreements. With Utility providers (Water, Sewer, Gas, Power, Telco and Cable) within the right of way should be reviewed to ensure that WTFs are properly addressed.
    c) Spacing, height and appearance as per The Virginia Statewide Building Code and all applicable government and industry standards should be considered.

9. Requests for new freestanding support structures in the City
    a) Freestanding support structures should be low impact in terms of location, siting, height, and design.

b) **Location:** New Wireless Telecommunications Facility towers and antennas should be constructed in locations (the property or general area where such facility is to be placed) that will provide the least negative impact on the community and that will avoid or minimize environmental impacts to the greatest extent practicable, consistent with Federal rules and regulations. The location should be compatible with surrounding land uses and not detrimental to the City's attractiveness, health, safety, and welfare. To help alleviate the negative impact associated with towers, please refer to Appendix C of this policy. A Wireless Telecommunications Facility does not have to be located in the most preferable locations if careful siting and low-impact design considerations mitigate its impact. The less preferable the location, the more critical siting, height, and design become in consideration of a proposed facility.

c) **Siting**: Siting refers to a specific point on a property where a Wireless Telecommunications Facility is to be constructed such as in the trees or on the roof. Strategic placement within trees or below a ridgeline can significantly reduce visibility of the facility. Wireless Telecommunications Facility locations at elevations lower than surrounding ridge lines, with adequate amounts of trees as a backdrop to eliminate "sky lining" and reduce visibility of the facility are preferred. If there is no other reasonable alternative and a proposed Wireless Telecommunications Facility must be located on a ridgeline, it should be placed on an available transmission line where such power line has already cut the ridgeline or on existing buildings or other structure located on ridgelines. Siting of facilities should not create a hazard to adjacent property or cause the over-development of property that result in an undue intrusion onto adjacent property.

d) **Height**: Reducing height can be an effective means of reducing the visual intrusiveness of a tower. Providers should document any requested height and conduct tests to demonstrate the visibility of the proposed facility from surrounding areas. Height considerations should include consideration of any lighting that may be required by other regulatory authority as a result of the proposed height and its effect on the visual impact of the tower.

e) **Design**: A well designed Wireless Telecommunications Facility can make a difference, particularly in areas of high visibility. Design considerations should include the size, height, bulk, and area of the tower or other support structure, associated equipment enclosures, and the types of antennas and mounting techniques as they relate to the overall height, size, and bulk of the tower.

WTF Elements:

i. Stealth
ii. Antennas
    1. Sector
    2. Dish
    3. Whip
iii. Tower Type:
    1. Monopoles are the preferred freestanding support structure.
    2. Stealth Disguise – include wooden masts/pole

3. Guyed wire and lattice towers are discouraged and should only be deployed in remote locations with minimal visibility.
4. Freestanding support structures should be no wider than the minimum necessary to support the proposed equipment.
5. Flush-mounted antenna arrays are preferred over distributed antenna arrays.
6. Antennas should be mounted close to the supporting structure and should be designed to minimize the profile.
7. Ground-based equipment should be limited in size and screened from view. Shelters are preferred to cabinets. Environmental Controlled Equipment Underground Vaults are preferred.
8. Towers should be painted with a neutral, flat paint which blends with its surroundings.
9. Lighting and reflective signs should be allowed only when required by other regulating bodies such as the Federal Aviation Administration.
10. Any advertising on towers should be prohibited.
11. Security fencing with vegetative screening should be provided. Vertical Board Fencing is preferred.
12. A Wireless Telecommunications Facility should adhere to all regulations from the FCC as to interference and Intermodulation.
13. Consideration for tree canopy in placement should be a design element for placement and siting.

10. <u>Items eligible for Administrative Approval.</u>
    a) Collocation on existing Wireless Telecommunication Facility, not to substantially change the physical dimensions as originally permitted.
    b) Maintenance, in-kind replacement.
    c) Stealth installations on existing structures, such as buildings and utilities.
    d) Mounted on rooftops, but screened per zoning ordinance as rooftop mechanical equipment
    e) WTFs installed on existing utility poles within the right of way, not to exceed 45 feet.

Appendix A: Definitions

- **Antenna - Dish:** A parabolic, spherical, or elliptical antenna intended to receive wireless communications.
- **Antenna - Omni-Directional (Whip):** A cylindrical antenna designed to transmit or receive signals in a three hundred sixty (360) degree pattern.
- **Antenna - Sector (Panel):** A directional antenna designed to transmit or receive signals in a directional pattern that is less than three hundred sixty (360) degrees. Sectorized antennas are grouped and mounted on either a host structure or on a freestanding support structure with one of two types of antenna arrays depending on polarization needs.
    - *Distributed Array:* Antenna array with protruding side arms or other extension devices to provide spacing of antennas.
    - *Flush-Mounted Array:* Antenna array attached flush to an antenna-supporting structure. Antennas are dual-polarized or cross-polarized eliminating the need to protrude from the support structure. Protrusions from the face of a pole are no greater than one-half (1/2) the diameter of the pole itself and in no case greater than twelve (12) inches.
- **Carrier:** An approved commercial legal entity by the Federal communications Commission that is authorized to sell voice and data service over a planned and engineered communications network.
- **Collocation:** A situation in which two (2) or more providers place an antennae on a common antenna-supporting structure, or the addition of antennas on an existing structure provided they meet the terms of the first installation.
- **Distributed Antenna System (DAS):** DAS systems are typically placed on buildings or existing poles in the public right-of-way such as utility, street lights, traffic signals, and so forth at relatively low and uniform heights and then hardwired back to a central hub. The systems are very scalable and efficient, but have high initial costs due to design and construction complexity of the network.
- **Freestanding Support Structures - Guyed Wire:** A freestanding, antenna-supporting structure supported by a series of guy wires that are connected to anchors placed in the ground. Typically 300 feet tall or more with antennas mounted on the exterior of the tower.
- **Freestanding Support Structures - Lattice:** A self-supporting, stand-alone antenna-supporting structure which consists of three to four sides of vertical and horizontal supports with multiple legs and cross bracing of structural steel. Typically between 100 and 400 feet tall with antennas mounted on the exterior of the tower.
- **Freestanding Support Structures - Monopole:** A freestanding, antenna-supporting structure that is composed of a single shaft of steel attached to a foundation. Typically between 100 and 200 feet tall with antennas mounted on the exterior of the tower. Wooden monopoles are called masts and are shorter and slimmer than steel monopoles. They are typically used in wooded settings, extending no more than 10 feet above the tallest tree within twenty-five (25) feet.

- **Freestanding Support Structures - Stealth:** A freestanding, antenna-supporting structure designed to appear to be something other than a wireless telecommunications facility.
- **Frequency Band**: Radio Frequencies that are measured in Megahertz (MHz) that are used to transmit and receive voice or data bits of information as provided by a commercial entity approved by the Federal Communications Commission.
    1. **Licensed** – Frequency use that the FCC has issued a License under CFR 47.
    2. **Un-Licensed** – Frequency use that the FCC has issued under CFR 47 that are open to the public under the CFR Code Section 15 that has careful stipulations and requirements.

- **Macrocell System** (or Full Site) systems enable service providers to deliver voice, text, and broadband communications through high powered radiofrequency (RF) signals to large geographic areas. These systems are typically characterized by multiple provider antennas affixed to tall, freestanding towers (on platforms for each service provider known as "slots"), the top of tall buildings, or water tanks.
- **Small cell System** is an umbrella term for Microcell and Picocell systems. These systems provide small footprint coverage to high traffic areas in need of supplemental capacity to support existing macrocell coverage much like DAS. The advantages of a Small Cell System are the ability to deploy individually to support a larger network and that the costs are less than that of DAS technology.
- **Stealth:** A wireless telecommunications facility that is hidden or not readily detectable by means of camouflage or concealment. Camouflage shall mean a way of painting and mounting a wireless telecommunications facility that requires minimal changes to the host structure in order to accommodate the facility. Concealment shall mean to enclose a wireless telecommunications facility within an existing structure or appurtenance of a structure resulting in the facility being either invisible or made part of the feature enclosing it. For the purpose of this policy, stealth will also include mounting on existing utility infrastructure not extending more than ten (10) feet above the highest horizontal plane. See examples for stealth in Appendix D.
- **Wireless Telecommunications Facility (WTF)** –The basic principle in the current deployment of wireless technology for current 4G and future technology innovations is that of what is known as a "WTF". Towers, rooftops, water tanks, tall signs and any elevated structures can accommodate antennas and equipment. This is why the reference to a wireless telecommunications facility or "WTF" encompasses several basic components. They are: Antennas, Cable, Base Equipment cabinets/shelter, Power source, Backhaul capability, Mounting devices, Structure to mount to: tower, water tank, street lamp post, roof tops, commercial signage, etc.

Appendix B: Public Input

The following survey was taken on-line in 2015 for the City residents to provide feedback on their wireless habits and opinions concerning service delivery and wireless facility deployment.

Questions with tabulated responses:

1. In which Quadrant of the City do you live?

Answer Choices	Responses	
NW	12.26%	13
SW	62.26%	66
NE	5.66%	6
SE	19.81%	21
Total		106

2. In what age range do you fit?

Answer Choices	Responses	
Less than 18 years old	0.00%	0
18-24 years old	1.83%	2
25-29 years old	5.50%	6
30-36 years old	11.01%	12
37-45 years old	20.18%	22
46-52 years old	17.43%	19
53 to 65 years old	31.19%	34
More than 65 years old	12.84%	14
Total		109

3. What type of phone or other wireless device that requires data streaming do you own?

Answer Choices	Responses	
Basic cell phone	13.76%	15
Smart phone	86.24%	94
Tablet	48.62%	53
Laptop	67.89%	74
NA	1.83%	2
Total Respondents: 109		

4. On average how often do you receive or send calls and text with your wireless phone?

Answer Choices	Responses	
N/A	0.92%	1
Several times a day	85.32%	93
Several times a week	8.26%	9
Occasionally	5.50%	6
Total		109

5. On average, how often do you e-mail or access the internet on your wireless phone or device?

Answer Choices	Responses	
N/A	7.34%	8
Several times a day	84.40%	92
Several times a week	4.59%	5
Occasionally	3.67%	4
Total		109

6. Do you consider your wireless device a convenience or a necessity?

Answer Choices	Responses	
Convenience	18.35%	20
Necessity	81.65%	89
No Opinion	0.00%	0
Total		109

7. How would you rate the quality of your service at your residence?

Answer Choices	Responses	
No Coverage	0.00%	0
Poor	19.27%	21
Average	40.37%	44
Above Average	20.18%	22
Excellent	19.27%	21
N/A	0.92%	1
Total		109

8. Do you use “wired” Wi-Fi internet service to access email or internet on your wireless phone or device while at home?

Answer Choices	Responses	
Yes	79.63%	86
No	17.59%	19
N/A	2.78%	3
Total		108

9. Do you use “wired” Wi-Fi internet service to access email or internet on your wireless phone or device while at work?

Answer Choices	Responses	
Yes	46.79%	51
No	34.86%	38
N/A	18.35%	20
Total		109

10. For what purpose do you use your wireless phone/device? Check all that applies.

Answer Choices	Responses	
Personal Use	98.17%	107
Business Use	75.23%	82
Educational Use	48.62%	53
Emergencies	65.14%	71
N/A	0.00%	0
Total Respondents: 109		

11. Have you cancelled your land line phone and just operate on a wireless phone?

Answer Choices	Responses	
Yes	57.80%	63
No	42.20%	46
Total		109

12. Rank the following wireless facilities collocated on an existing structure in terms of visual preference. Each facility must be assigned a unique number with 1 being the least appealing and 4 being the most appealing.

	1	2	3	4	Total	Score
	15.29% 13	12.94% 11	42.35% 36	29.41% 25	85	2.14
	14.12% 12	37.65% 32	35.29% 30	12.94% 11	85	2.53
	36.56% 34	31.18% 29	18.28% 17	13.98% 13	93	2.90
	23.81% 25	12.38% 13	11.43% 12	52.38% 55	105	2.08

13. Rank the following freestanding towers in terms of visual preference. Each facility must be assigned a unique number with 1 being the least appealing and 4 being the most appealing.

	1	2	3	4	Total	Score
	40.96% 34	20.48% 17	24.10% 20	14.46% 12	83	2.88
	6.02% 5	38.55% 32	44.58% 37	10.84% 9	83	2.40
	16.49% 16	12.37% 12	18.56% 18	52.58% 51	97	1.93
	40.78% 42	30.10% 31	17.48% 18	11.65% 12	103	3.00

14. Which antenna type do you prefer?

Answer Choices	Responses	
	5.88%	6
	94.12%	96
Total		102

15. For freestanding cell towers, would you rather see a greater number of short towers (10' above the tree line) or fewer tall towers (up to 200' monopole)?

Answer Choices	Responses	
10' above the tree line	45.19%	47
200' monopole	34.62%	36
No Opinion	20.19%	21
Total		104

16. Rank the following land use types in terms of appropriateness for a freestanding tower (1would be deemed most appropriate.)

	1	2	3	4	5	6	7	8	Total	Score
Neighborhood commercial (e.g. Grandin Village, 10th and Williamson NE)	4.60% 4	6.90% 6	11.49% 10	14.94% 13	22.99% 20	20.69% 18	11.49% 10	6.90% 6	87	4.13
Single-family residential	5.43% 5	2.17% 2	2.17% 2	4.35% 4	2.17% 2	6.52% 6	26.09% 24	51.09% 47	92	2.25
Downtown	4.65% 4	9.30% 8	24.42% 21	25.58% 22	12.79% 11	15.12% 13	4.65% 4	3.49% 3	86	4.86
Industrial	57.95% 51	15.91% 14	12.50% 11	5.68% 5	1.14% 1	0.00% 0	4.55% 4	2.27% 2	88	6.94
Large-scale commercial (e.g. Valley View Mall)	21.51% 20	50.54% 47	9.68% 9	3.23% 3	5.38% 5	4.30% 4	4.30% 4	1.08% 1	93	6.44
Institutional (e.g. churches, schools)	6.82% 6	4.55% 4	22.73% 20	28.41% 25	21.59% 19	7.95% 7	5.68% 5	2.27% 2	88	4.89
Agricultural or Recreation and Open Space	10.75% 10	7.53% 7	13.98% 13	12.90% 12	13.98% 13	19.35% 18	4.30% 4	17.20% 16	93	4.27
Multifamily residential	1.03% 1	3.09% 3	9.28% 9	5.15% 5	17.53% 17	20.62% 20	32.99% 32	10.31% 10	97	3.20

Appendix C: Matrices

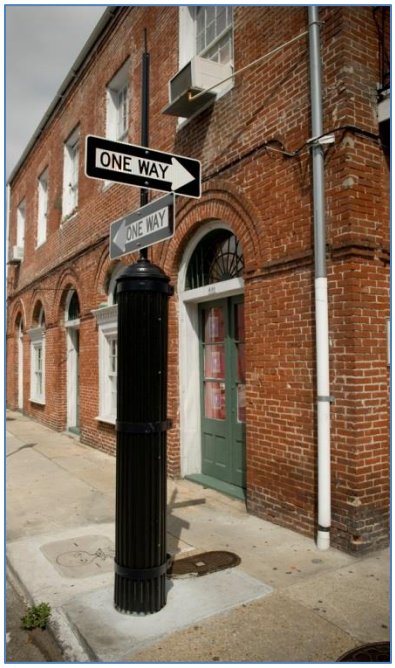
Facilities preferred by Zoning Districts

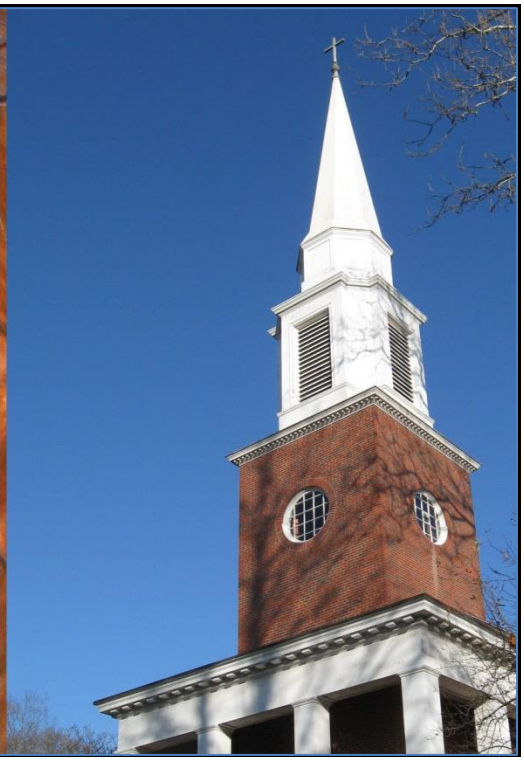
Districts	Preferred Facility
I-2, Heavy Industrial I-1, Light Industrial AD, Airport CLS, Commercial Large Site CG, Commercial General	• Freestanding Support Structure: Monopole; Guyed Wire; Lattice Tower; or Stealth • Collocation • Stealth • Building-Mounted; Utility Infrastructure • Antennas: Distributed Array or Flush-Mounted
D, Downtown UF, Urban Flex MX, Mixed Use	• Collocation • Stealth • Building-Mounted; Utility Infrastructure • Antennas: Distributed Array or Flush-Mounted
CN, Commercial Neighborhood IN, Institutional RMF, Residential Multifamily RM-2, Residential Mixed-Density RA, Residential Agricultural ROS, Recreation and Open Space	• Collocation • Stealth • Building-Mounted • Antennas: Flush-Mounted
RM-1, Residential Mixed Density R-3, Residential Single-Family R-5, Residential Single-Family R-7, Residential Single-Family R-12, Residential Single-Family	• Collocation • Stealth • Antennas: Flush-Mounted
MXPUD, Mixed Use Planned Unit Development INPUD, Institutional Planned Unit Development IPUD, Industrial Planned Unit Development	• To be determined by rezoning process • Based on character and zoning of the surrounding area • Based on the size of PUD
ROW- Right of Way	• Collocation • Stealth • Utility Infrastructure

Other factors:

- Proximity to less intense land use
- Topography (protecting view sheds and ridgelines)
- Proximity to historic district (H-1, H-2, National, State)
- Proximity to airport or medical helicopter flight path

Appendix D: Examples of Stealth Technology






BB&T


STOP